

CLAIMS

1. (currently amended) A computer-implemented method for classifying/retrieving an attribute associated with a data packet by determining whether comprising a search object comprising information within the data packet matches a search node in a knowledge base, wherein the knowledge base comprises using a decision tree structure comprising a plurality of search nodes defining a plurality of paths through the decision tree structure, each at least one path comprising a plurality of search nodes, and a one or more joining links between adjacent search nodes, and a leaf, said method comprising:

storing a first portion of the decision tree structure in a first memory, having a first memory access time, wherein the first portion comprises a first plurality of set of one or more search nodes, and zero or more joining links, and zero or more leaves;

storing a second portion of the decision tree structure in a second memory, having a second memory access time, wherein the second portion comprises a second plurality of set of one or more search nodes and, zero or more joining links, and one or more leaves, and wherein the first memory access time is less than the second memory access time;

implementing one or more times, starting with a root search node in the first memory, the steps of:

(1) reading at least a portion of one or more paths through a current search node from one of the first memory and the second memory;

(2) comparing, at the current search node, with at least a portion of the search object with the at least a portion of the one or more paths through the current search node; and

(3) based on a result of the step of comparing, traversing a search path from the current search node to: (i) a next search node via the joining link therebetween, or (ii) a leaf, and successively executing the steps of comparing and traversing to define a path through the decision tree structure, wherein the search path terminates at a terminal search node matching the search object to classify the data packet the leaf providing the attribute associated with the data packet; and retrieving the attribute associated with the data packet.

2. (currently amended) The method of claim 1 wherein the ~~information within the data packet~~ search object comprises at least part of a destination address of the data packet.

3. (canceled)

4. (original) The method of claim 1 wherein the step of reading is executed by a processor formed in an integrated circuit, and wherein the first memory is formed on the integrated circuit, such that the step of reading search nodes from the first memory executes faster than the step of reading search nodes from the second memory.

5. (currently amended) The method of claim 1 wherein the first portion of the decision tree structure comprises the search nodes near the first root search entry node.

6. (original) The method of claim 1 wherein the decision tree structure comprises a plurality of levels, each comprising a plurality of search nodes, and wherein the search nodes comprising one of the plurality of levels are connected to search nodes comprising another one of the plurality of levels by links.

7. (previously presented) The method of claim 6 wherein a predetermined number of lower levels of the plurality of levels are stored in the first memory, and wherein a remaining plurality of levels are stored in the second memory.

8. (original) The method of claim 7 wherein the predetermined number of lower levels of the plurality of levels have a faster read access time than the remaining plurality of levels.
9. (canceled)
10. (original) The method of claim 1 wherein the search object comprises a plurality of symbols.
11. (original) The method of claim 10 wherein the symbols comprise a plurality of binary bits.
12. (currently amended) The method of claim 1 wherein the ~~knowledge-based decision tree structure~~ comprises a classification engine of a communications network processor for determining an attribute of ~~[[the]]~~ data input thereto, and wherein the second portion of the decision tree ends in a plurality of ~~terminating nodes/leaves~~, the method further comprising repeating the steps of reading, comparing and traversing until a ~~terminating node/leaf~~ is reached, wherein the ~~terminating node/leaf~~ identifies the attribute of the input data.
13. (canceled)
14. (currently amended) The method of claim 1 wherein each one of the plurality of search nodes comprises an instruction and an address field, wherein the step of comparing further comprises comparing at least a portion of the search object with the instruction, and wherein the address field determines the ~~second-next~~ search node based on the comparing step.
15. (original) The method of claim 1 wherein the decision tree structure comprises a plurality of contiguous tree levels, wherein each tree level further comprises a search node and link to a search node of the next adjacent tree level.
16. (original) The method of claim 15 wherein the first portion of the decision tree structure comprises a predetermined number of contiguous tree levels and the second portion of the decision tree structure comprises the remaining contiguous tree levels.
17. (original) The method of claim 15 wherein the first portion of the decision tree structure comprises a portion of one or more contiguous tree levels.
18. (currently amended) An apparatus for retrieving an attribute associated with a data packet comprising determining whether a search object matches a search node in a knowledge base, wherein the knowledge base comprises using a decision tree structure comprising a plurality of search nodes defining a plurality of paths through the decision tree structure, each at least one path comprising a plurality of search nodes and, one or more joining links between adjacent search nodes, and a leaf, said apparatus comprising:
 - a first memory having a first memory access time and ~~storing-adapted to store~~ a first portion of the decision tree structure;
 - a second memory having a second memory access time and ~~storing-adapted to store~~ a second portion of the decision tree structure wherein the first memory access time is less than the second memory access time; and
 - a processor adapted to retrieve the attribute associated with the data packet by implementing one or more times, starting with a root search node in the first memory, the steps of:
 - (1) reading at least a portion of one or more paths through a current search node from one of the first memory and the second memory;

(2) comparing, at the current search node, at least a portion of the search object with the at least a portion of the one or more paths through the current search node; and

(3) based on a result of the step of comparing, traversing a search path from the current search node to: (i) a next search node via the joining link therebetween, or (ii) a leaf,

wherein the search path terminates at the leaf.

~~for successively determining whether at least a portion of the search object matches a search node to define a path comprising search nodes and adjoining links through the decision tree structure until a terminal search node is reached, the terminal search node matching at least a portion of the search object.~~

19. (canceled)

20. (original) The apparatus of claim 18 wherein the processor and the first memory are formed in the same integrated circuit, such that reading search entries from the first memory is faster than reading search entries from the second memory.

21. (canceled)

22. (original) The apparatus of claim 18 wherein the decision tree structure comprises a plurality of levels, each comprising a plurality of search nodes, and wherein the search nodes comprising one of the plurality of levels are connected to search nodes comprising an adjacent one of the plurality of levels by a link, and wherein the first memory stores at least the first level.

23. (currently amended) An apparatus for retrieving an attribute associated with a data packet comprising determining whether a search object matches a search node in a knowledge base, wherein the knowledge base comprises using a decision tree structure comprising a plurality of links connecting adjacent paths through the decision tree structure, at least one path comprising a plurality of search nodes, one or more joining links between adjacent search nodes, and a leaf, to define paths through the decision tree structure said apparatus comprising:

a first processor adapted to access a first memory;

a second processor adapted to access a second memory;

[[a]] the first memory having a first memory access time and storing adapted to store a first portion of the decision tree structure; and

[[a]] the second memory having a second memory access time and storing adapted to store a second portion of the decision tree structure wherein the first memory access time is less than the second memory access time,

~~wherein said first processor accesses said first memory, and wherein said second processor accesses said second memory for successively determining whether at least a portion of the search object matches a search node to define a path through the decision tree structure until a terminal search node is reached, said terminal search node matching at least a portion of said search object are adapted to retrieve the attribute associated with the data packet by implementing one or more times, starting with a root search node in the first memory, the steps of:~~

(1) reading at least a portion of one or more paths through a current search node from one of the first memory and the second memory;

(2) comparing, at the current search node, at least a portion of the search object with the at least a portion of the one or more paths through the current search node;

(3) based on a result of the step of comparing, traversing a search path from the current search node to: (i) a next search node via the joining link therebetween, or (ii) a leaf,

wherein the search path terminates at the leaf.

24. (original) The apparatus of claim 23 wherein the first processor compares at least a portion of the search object with one or more search nodes stored in the first memory to traverse through the first portion; and

wherein after the first portion of the decision tree has been traversed, the second processor compares at least a portion of the search object with one or more search entries stored in the second memory to traverse through the second portion until a search node matching at least a portion of the search object is determined.

25. (original) The apparatus of claim 23 wherein the first processor and the second processor simultaneously execute tree searches for a plurality of search trees.

26. (new) The method of claim 1, wherein the attribute associated with the data packet is presence or absence in the decision tree structure of a leaf that matches the search object.

27. (new) The method of claim 1, wherein, if the search object does not match any leaf in the decision tree structure, then the retrieved attribute is absence in the decision tree of a matching leaf.

28. (new) The method of claim 1, wherein the attribute associated with the data packet is a classification for the data packet, wherein the classification is associated with the leaf terminating the search path.

29. (new) The method of claim 1, wherein:
each path terminates in a leaf;
the at least a portion of the search object is a single character; and
for at least one current search node, there are a plurality of paths through the current search node, and the at least a portion of the plurality of paths through the current search node comprises a plurality of single characters, each character from a different path through the current search node.

30. (new) The method of claim 1, wherein:
each path terminates in a leaf; and
the decision tree structure comprises:
a first type of path corresponding to a match of the search object; and
a second type of path corresponding to a failure to match the search object.

31. (new) Apparatus comprising:
a first memory adapted to store a first portion of a decision tree structure and having a first access time;
a second memory adapted to store a second portion of the decision tree structure and having a second access time different from the first access time; and
at least one processor adapted to traverse a search path in the decision tree structure corresponding to a specified search object, wherein:
the specified search object comprises (1) a first part contained in the first portion of the decision tree structure and (2) a second part contained in the second portion of the decision tree structure;
and

the at least one processor is adapted to traverse (1) a first part of the search path by accessing the first memory to identify the first part of the specified search object and (2) a second part of the search path by accessing the second memory to identify the second part of the specified search object.

32. (new) The invention of claim 31, wherein:
the first portion of the decision tree structure comprises one or more lower levels of the decision tree structure;
the second portion of the decision tree structure comprises one or more higher levels of the decision tree structure; and
the first memory access time is less than the second memory access time.

33. (new) The invention of claim 31, further comprising a third memory adapted to store the first portion of the decision tree structure and having a third access time different from the second access time, wherein the at least one processor comprises:

a first processor adapted to traverse a first search path in the decision tree structure corresponding to a first specified search object, wherein:

the first specified search object comprises (1) a first part contained in the first portion of the decision tree structure and (2) a second part contained in the second portion of the decision tree structure; and

the first processor is adapted to traverse (1) a first part of the first search path by accessing the first memory to identify the first part of the first specified search object and (2) a second part of the first search path by accessing the second memory to identify the second part of the first specified search object; and

a second processor adapted to traverse a second search path in the decision tree structure corresponding to a second specified search object, wherein:

the second specified search object comprises (1) a first part contained in the first portion of the decision tree structure and (2) a second part contained in the second portion of the decision tree structure; and

the second processor is adapted to traverse (1) a first part of the second search path by accessing the third memory to identify the first part of the second specified search object and (2) a second part of the second search path by accessing the second memory to identify the second part of the second specified search object.

34. (new) The invention of claim 33, wherein:

the first processor and the first memory are implemented on a first integrated circuit;
the second processor and the third memory are implemented on a second integrated circuit; and
the second memory is not part of either the first or second integrated circuit.

35. (new) The invention of claim 31, wherein the at least one processor comprises:

a first processor adapted to traverse the first part of the search path by accessing the first memory to identify the first part of the specified search object; and

a second processor adapted to traverse the second part of the search path by accessing the second memory to identify the second part of the specified search object.

36. (new) The invention of claim 35, wherein, after traversing the first part of the search path, the first processor passes control to the second processor to traverse the second part of the search path.

37. (new) The invention of claim 35, wherein the first processor and the first memory are implemented on a single integrated circuit.

38. (new) The invention of claim 31, wherein the at least one processor comprises a first processor adapted to access simultaneously (1) the first portion of the decision tree structure in the first memory and (2) the second portion of the decision tree structure in the second memory.

39. (new) The invention of claim 31, wherein:
the at least one processor comprises a first processor implemented on a first integrated circuit together with the first memory; and
the second memory is not part of the first integrated circuit.